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Revegetation and Plant Succession Along Salt Ford Creek

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REVEGETATION AND PLANT SUCCESSION ALONG SALT FORK CREEK

BY

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B. A. Mount Holyoke College, 1916

THESIS

Submitted in Partial Fulfillment of the Requirements for the

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Chi Nyak Wang

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BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF Master of Arts

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REVEGETATION AND PLANT SUCCESSION ALONG SALT FORK CREEK

by

Chi Nyok Wang.

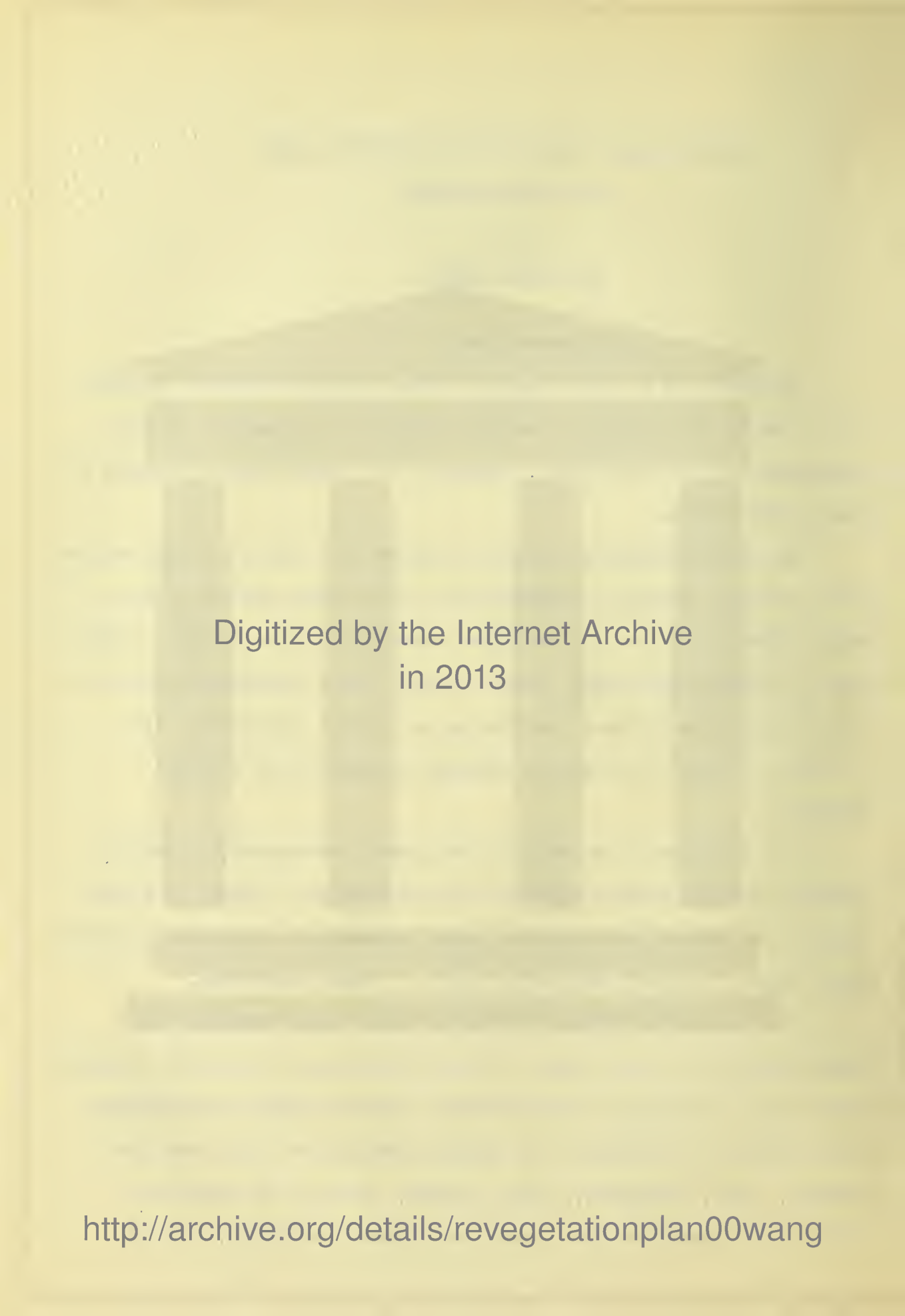
I. Introduction.

Illinois is a very typical state for the study of ecological botany. It occupies a unique position in respect to the vegetation of the continent, marking the transitional regions of four great floras.

The Austroriparian Province enters the state at the extreme south end and extends northward into the lower valley of the Wabash River where well developed examples of the cypress swamp tree (Taxodium distichum) still occur. Other scattered species of this affinity are found decreasing in number northward till at last the limit is reached through northern and central Illinois.

The southern boundary of the great northeastern Conifer Province passes across Wisconsin and Michigan. Relics of Pinus Strobus and Larix laricina are seen, however, in northern Illinois which forms the real southern limit of these conifers.

The Deciduous Forest Province which lies between the Austroriparian on the south and the Conifer on the north occupies vast plains extending latitudinally from the Appalachian Mountain system to Nebraska. The typical genera in this area are Quercus, Acer, Fraxinus, Tilia, Fagus, etc. In the eastern part of the province the forest is almost continous, but at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the west from Indiana and Illinois to Nebraska, it becomes discontinuous until the land at last is completely occupied by the prairie.

The Prairie Province, last of the four, "extends in a long strip north and south through the Great Plain at the eastern base of the Rocky Mountains from Texas to Sascatchewan, and an eastward extension passes across Iowa and Illinois into Indiana, sharing the area with the deciduous forest". So then Illinois marks roughly the boundary of Austroriparian on the south, conifer on the north, deciduous forest on the east, and prairie on the west.(1)

Illinois as a state is largely prairie, yet it has never been entirely treeless. In many sections large areas have been denuded of timbers, but the wood-land at the present time varies from 6% to 27% of the total area in different counties.. Champaign County, in which the city of Urbana is located and where the work detailed in this paper was done, lies in the east central part of the state and is grouped among the seventeen counties with 6% of wood-land (2). About a mile north west from the center of the city of Urbana is the position of Salt Fork Creek which furnishes the field for the present work (Fig. I,6).

This region was very different in the past than at present. In the seventies of the last century the place was all covered with a deciduous forest which extended far to the eastward but ended immediately into a prairie on the west (Fig. I,7). About twenty-five years ago most of the woods were cut down and an artificial lake, the present Crystal Lake (Fig. I,4)

was first formed by putting up dams and dredging. Still later, in 1910, a further improvement was made by straightening and enlarging the zig-zag Creek (Fig.II).

For some distance the excavated soil was thrown up on either side of the Creek and the banks were thus built up to an elevation of from ten to fifteen feet above the surrounding soil level.(These embankments are designated by ff in figure II.) By so doing part of the original vegetation was destroyed; new soil exposed, plant habitats changed. As a result new invaders appeared to compete with the left overs and brought about the conditions that are to be described. The studies on which the present paper is based were confined primarily to that portion of the Creek which is between the two bridges, indicated by dd in figure II, and its banks.

Observation and Experiment.

A. Description of the Vegetation.

In order to make a detailed study of the different successions and vegetation movements, the whole region was arbitrarily divided into eight subdivisions as indicated with Roman numerals in figure II.

Subdivision I begins at the south bridge on the west side of the stream. The first part of the bank here is covered with a retaining wall of cement. This has been constructed for the purpose of preventing the rapid erosion going on at this place and naturally no plants have a chance to grow here except below the wall along the edge of the water where Elodea and some sedges and grasses are found. A little further north is the place where the old ditch branches off from the new. Here

several types of vegetation meet to form a very complex group of plants. On one hand the invaders such as Salix, Melilotus, Xanthium, and Muhlenbergia are getting a foot-hold on the newly exposed soil. Side by side with these, on the other hand, are plants of a very different type such as young elm trees, and maple and ash seedlings. Toward the west along the old stream south of the pasture (C in fig. II), the original soil was hardly disturbed. Here larger trees and shrubs are found, including willows of more than ten feet tall and maples of about six feet, and large elm trees, some ash, and button bush. There are also many stumps of large trees along this part of the old stream as well as throughout the pasture. Plants on the area of subdivision I are:

Trees and Shrubs.
- Ulmus americana
- Sambucus canadensis
- Cephalanthus occidentalis
- Salix longifolia
- Fraxinus pennsylvanica Var. lanceolata
- Acer saccharinum

Herbaceous perennials and biennials.
- Elymus virginicus
- Arctium lappa
- Melilotus alba
- Medicago falcata
- Cirsium lanceolatum
- Hordeum pusillum
- Pastinaca sativa
- Poa pratensis
- Taraxacum officinale
- Aster paniculatus
- Achillea Millefolium
- Verbascum Thapsus
- Nepeta hederacea

Annuals
- Xanthium commune
- Polygonum hydropiper
- Setaria glauca

Panicum capillare
Panicum virgatum
Ambrosia artemisiifolia
Ambrosia trifida
Rumex crispus
Carex riparia
Scirpus fluviatilis
Plantago Rugelii
Oenothera biennis

Subdivision II occupies the very top of the west bank with an elevation from ten to fifteen feet above the surrounding soil level. The slope is very steep on the side toward the water but more gentle on the west side which slopes gradually into the pasture. On the highest part there is almost nothing except patches of Euphorbia maculata and some Poa pratensis or Sporobolus neglectus. Along and at the foot of the different furrows down which water runs during and after rains, elm seedlings commonly occur with occasional patches of wild rose. A solitary plant of Cirsium lanceolatum was found at the foot of one of the furrows. Gradually toward the north the ridge slopes downward until it disappears at the level of the adjacent pasture within a few feet of the north bridge. The conditions for growth are greatly improved here and more annuals and perennials are found--especially such weeds as Ambrosia, Chenopodium, Lactuca, Solanum, etc. A complete list of plants collected on this area follows:

Shrubs.
Ulmus americana
Rosa sp.

Herbaceous perennials and biennials.
Cirsium lanceolatum
Solanum carolinense
Melilotus alba

Annuals
Ambrosia trifida
Ambrosia artemisiifolia

Euphorbia maculata
Sporobolus neglectus
Chenopodium album
Rumex crispus

Subdivision III: this area occupies the north end of the east bank. The conditions here would have been about the same as that of the north end of subdivision II, but that because of the influence of the forest near by (e in fig. II), the degree of relative humidity and light intensity are more favorable. Hence plant life is much more abundant and in a much later stage of succession. Besides the annuals and perennials, trees and shrubs of a more mesophytic nature such as willows, elms, ashes, poplars, oaks, etc., begin to appear. Most of these, however, are in the shrub stage. The list of plants collected follows:

Trees and shrubs.
Populus deltoides
Salix nigra
Quercus alba
Acer saccharum
Ulmus americana

Herbaceous perennials and biennials.
Dipsacus sylvestris
Aster lateriflorus
Phleum pretense
Solanum corolinense

Annuals.
Oenothera biennis
Carex sp.
Chenopodium album
Lactuca scariola
Poa pratensis
Ceratodon purpureus
Muhlenbergia sp.

Subdivision IV is a continuation of the previous subdivision and is similar to subdivision II on the opposite side of the stream. The ecological factors likewise are about the

same. On the summit here again Euphorbia maculata and patches of Poa pratensis are pratically the only plants. But as the bank slopes down on the east side vegetation becomes more abundant until one comes to a fence row along the forest remnant (e in fig. II). Here in addition to herbaceous plants, trees such as poplars, ash, and elm, and grape vines and rose bushes are well established while the intervening spaces are covered with clover, composites and many other weeds and grasses. The plants found in this section are given in the following list.

Trees and shrubs.
- Populus deltoides
- Fraxinus pennsylvanica var. lanceolata
- Ulmus americana
- Quercus alba
- Rosa sp.

Herbaceous perennials and biennials.
- Nepeta hederacea
- Melilotus alba
- Aster sp.
- Pastinaca sativa
- Cirsium lanceolatum

Annuals.
- Plantago rugelii
- Poa pratensis
- Poa compressa
- Euphorbia maculata
- Scirpus fluviatilis

Subdivision V extends from the south end of subdivision IV to the south bridge. On the first part of this, there is an almost pure stand of Melilotus alba growing on the lime stone soil thrown up from the bottom of the ditch. From the foot of the embarkment to the south bridge the vegetation is to a certain extent, similar to some parts of section I on the opposite side of the stream. Here a great variety of weeds and grasses are found. Elms, poplars and willows are also

found here. In addition to these, six honey locusts (Gleditsia triacanthos) have grown into quite large trees although this species is not found any where else on the area studied. The list of plants on this subdivision is as follows.

Trees and shrubs.
- Gleditsia triacanthos
- Ulmus americana
- Quercus alba
- Fraxinus pennsylvanica var. lanceolata
- Salix nigra

Herbaceous perennials and biennials.
- Melilotus alba

Annuals.
- Setaria glauca
- Panicum capillare
- Panicum virgatum
- Rumex crispus
- Chenopodium album
- Ambrosia artemisiifolia

The following three subdivisions are along the lower bank of the ditch next to the water.

Subdivision VI covers the entire west side. On the whole the slope is rather steep and erosion rapid; the conditions for growth are severe; vegetation is sparce. At places where the angle of slope is more than 35° there is hardly any vegetation except a few patches of Euphorbia maculata and grasses. While in some crevices tufts of cinquefoil (Potentilla monspeliensis) are trying to get a foot hold. Near the level of the water, however, plants become more common. At places Panicum virgatum and Scirpus fluviatilis are the most dominant plants with a few Xanthium and willows. At other places the latter play the dominant part. These are almost the only plants occupying the southern three fourths of the bank but at the north this sparse vegetation merges into a nearly pure stand of

willows (S. nigra) with a few Xanthium plants. Then near the north bridge the willows begin to be mixed with other plants much as Rumex, Cirsium, Ambrosia, Oenothera, Polygonum, etc. A list of the plants of this subdivision follows.

Trees and shrubs.
- Ulmus americana
- Salix nigra
- Salix longifolia
- Acer saccharum

Herbaceous perennials and biennials.
- Muhlenbergia racemosa
- Muhlenbergia mexicana
- Agrostis alba
- Xanthium commune
- Medicago sativa
- Aster sp.
- Cirsium lanceolata
- Potentilla monspeliensis

Annuals.
- Scirpus fluviatilis
- Scirpus validus
- Panicum virgatum
- Panicum capillare
- Plantago rugelii
- Euphorbia maculata
- Polygonum persicaria
- Polygonum convolvulus
- Rumex crispus
- Ambrosia trifida
- Chenopodium album
- Datura Tatula

Subdivisions VII and VIII include the entire stream-ward slope on the east side--the former includes the little steep portion of the slope (as shown in fig. II, VII) and the latter includes the rest of the section. On this side the whole slope is quite thickly covered with vegetation, which is a distinct contrast to the west side, with the exception of the small area (indicated as subdivision VII) where the slope is too steep to permit much growth. At such places only Euphorbia, willow seedlings and tufts of grasses are able to struggle along. Now, be-

ginning at the north bridge, one meets a great variety of plants--largely composites, and other weeds, and grasses mingled with a number of willow and elm seedlings. A little further south (before coming to subdivision VII in fig. II) the natural conditions have been partially destroyed so that there is a bare gap with some remains of woody plants that have been cut down by man, lying about. All vegetation has been artificially destroyed except along the water edge where grasses and carex are still surviving. Willow seedlings are also found mingled with sedges and grasses and they become more numerous southward. Then comes the steep portions, subdivision VII, which has already been mentioned. Beyond this the lower level, where it is quite wet, is thickly covered with sedges, grasses, clovers, and some less typical plants such as Alfalfa, Ambrosia, etc. A little higher up at an angle of more than 34° Euphorbia maculata and Poa pratensis are as usual the only vegetation. Still southward the stream begins to turn toward the east. Here the slope is not especially steep but erosion is rather rapid. A single good sized poplar leaning far toward the stream indicates the rapidity of erosion at this spot. A little farther south, half a dozen elm trees have their roots half exposed which likewise proves to us the severity of the erosion as well as the ability of those trees to grow under such adverse conditions. On such rapid-eroding places no vegetation can secure a foot hold until the soil slopes down to almost the level of the water where carex usually becomes the pioneer again. Finally at the south end of the subdivision the slope is very gradual and vegetation once more becomes abun-

dant--rag weed, primrose, sweet clover, sedges, rushes, and several kinds of grasses occur. This condition continues clear to the south bridge. Plants found in subdivision VII are:

Trees and Shrubs.
Salix nigra

Herbaceous biennials.
Pastinaca sativa
Lepidium virginicum
Melilotus alba

Annuals.
Daucus Carota
Ambrosia artemisiifolia
Chenopodium album
Juncus effusus
Euphorbia maculata
Setaria glauca
Scirpus sp.
Muhlenbergia mexicana
Panicum virgatum
Carex sp.

Those of subdivision VIII are:

Trees and shrubs.
Populus deltoides
Salix nigra
Salix longifolia
Ulmus americana

Herbaceous perennials and biennials.
Medicago falcata
Elymus canadensis
Melilotus alba
Leesia oryzoides
Asclepias syriaca
Poa pratensis
Aster ericcides
Aster paniculatus
Calamagrostis canadensis
Brassica nigra
Eupatorium serotium
Trifolium repens
Potentilla monspeliensis

Annuals.
Phleum pratense
Panicum capillare
Panicum virgatum
Rumex crispus
Echinochloa Walterii

Scirpus validus
Carex sp.
Oenothera biennis
Chenopodium album
Ambrosia trifida
Erigeron canadensis

B. Ecological Factors.

1. Climate.

A summary of the climate of Urbana during 1916 is given in table I. 1916 was a fairly typical year except that the rainfall was a little lower and the number of clear days a little higher than the average.

1916	Temperatures			Rainfall in in.	Mean Rel. Humidity	Wind Av. vel.	Wind Dir.	No. of clear days	No. of partly clear days	No. of cloudy days.
	Max	Min	Mean							
Jan.	61	-9	29.7	6.02	84.3	11.3	S.	9.	3	19
Feb.	61	-7	26.6	.63	79.8	9.0	NW	8	7	14
Mar.	77	1	37.4	1.14	79.0	10.7	N	7	9	15
Apr.	80	26	50.6	1.28	68.9	10.2	NW	6	3	21
May	88	36	64.0	5.70	71.1	9.1	SW	7	10	14
June	92	52	67;9	3.88	74.0	8.0	SW	9	11	10
July	101	61	82.3	.47	61.9	5.2	NE	24	4	3
Aug.	97	50	78.2	1.72	64.7	5.6	SW	15	7	9
Sept.	92	32	69.2	2.69	64.7	6.6	SW	13	9	8
Oct.	86	30	54.4	2.26	66.0	6.8	S	16	4	11
Nov.	75	12	43.4	1.93	69.5	10.4	SW	15	7	8
Dec.	66	-6.5	27.6	1.99	77.6	9.6	W	11	13	7
Totals				29.71				140	87	139
Av.	81.3	23.1	52.3	2.48	71.8	8.5	SW	11.7	7.2	11.6

Table I: weather conditions at Urbana during 1916--- As compiled by the Agricultural Experiment Station of the University of Illinois.

2. Physical Factors.

Table II given below is the record of a comparative study of water content, light intensity, relative humidity, and kind of soil at the place where the work of this paper was done.

Number of Subdiv.	I	II	III	IV	V	VI	VII	VIII
% of water	29%	12.4%	19.4%	12.4%	12.9%	16.1%	19.2%	19.2%
% of light at 0 ft.	80%	87.5%	80%	88%	90%	40%	90%	70%
% of light at 3 ft.	86.6%	120%	93.3%	120%	120%	50%	110%	114%
Rel. Humidity at 0 ft.	52	48	71	51	56	54	51	51
Rel. Humidity at 3 ft.	51	45	47	45	51	52	48	45
Kind of Soil	silty clay loam	fine sandy loam with high% of gravel	silty clay loam gravel	fine sandy loam with high % of gravel	sandy limestone plus gravel	sandy loam	same as VI	same as VI

Table II: water content, light intensity, relative humidity, and kind of soil, as determined by instrumental methods.

The percentage of water content of the soil was obtained by the usual method of drying to constant weight and calculating the loss of water on the basis of the dry weight of the soil. Soil samples were obtained from each subdivision by scraping away the dry surface layer and taking a sample immediately below this by means of a geotome. The samples

were carried to the laboratory for weighing in air tight can.

The light intensity was measured by means of a photometer using solio paper, and exposing for known time intervals. The results were compared with a standard, which was prepared by making a series of exposures on the campus at the University of Illinois at noon on a bright day in the early part of October. The relative lengths of exposure giving comparable color intensities are expressed in the table in percentages. Two readings were taken in each subdivision, one just above the surface and the other three feet above the surface.

For relative humidity a modification of the cog psychrometer used by Clements was employed. Careful readings of both wet and dry bulb thermometers were taken and these readings were then referred to the tables of relative humidity prepared by the U. S. Weather Bureau and the relative humidity of each place thus obtained. Here too, two records were taken at each subdivision--one at the surface and the other three feet above the soil. The records thus obtained are lower than those given in table I; due to the fact that the readings here are for day time only while those in table I include night as well.

The original soil of the region is largely silty clay loam, while that thrown up from the creek is a fine sandy loam with a high percentage of gravel.

Some observations were made in regard to the degree of slope. This was done by means of a combined clinometer and compass, manufactured by C. H. Stoelting and Company of Chicago, Illinois. By the use of this instrument it was found that the

degree of slope varies from zero at the water level to 55° high er up on the west side. On the opposite side the slope is comparatively more gradual. It varies from about 22° along the water level to 34° higher up except the little portion of subdivision VII where it is from 14° - 55°. On the whole wherever the angle of slope is more than 35° or 40° hardly any vegetation is found except grasses, Euphorbia and cinquefoil.

All the observations given above were made during the months of November and December, 1916, when the weather was rather uncertain, so most of the figures given are by no means to be taken as absolutely accurate.

Discussion.

The factors involved in this region may be classified as biotic, ecesic, climatic, edaphic and topographic.

1. Biotic factors are those which have to do with the influence of man, animals and plants.

2. Ecesic factors are those by which the succession"is given a distinctive character by the responses and adjustments which the community makes to its habitat, namely migration, ecesis, competition and reaction". (3)

3. Climatic or atmospheric factors: "By atmospheric factors are meant those which influence the aerial parts of plants. They include radiant energy in the form of heat and light, and also the influence of wind. Heat may also be an ecological factor". (4).

4. Edaphic factors have to do with the nature of soil, the depth of the soil, the water content of the soil, the heat absorbing quality of the soil, the amount of humus and

chemical properties in the soil, and the bacteria in the soil (4).

5. Topographic factors or causes: "The various processes which control land forms and hence the surface available for succession are (1) erosion, (2) deposition ,(3) flooding, (4) drainage, (5) elevation, and (6) subsidence." (4)

Since now the conditions along this newly formed creek are similar to those of a flood plain or of a young river as described in the work of G. E. Nichols (5),topographic factors become very important--especially erosion, deposit, and submersion. On both sides of the dredge bank, erosion is still rapidly going on to-day--especially higher up. This action is largely due to the water running off from the top during and after each heavy rain. While lower down near the water level the conditions are very much like a young river where the current is swift and wears the floor and the sides of the channel (5). In this case, owing to the shape of the creek and the direction of the current which runs south east, erosion is going on along the west bank beginning immediately from where the curve starts (fig.I), and on the opposite side deposition takes place. Thus at places, namely along the south end of the east bank, surface is built up little by little near the water level and erosion is vigorously taking place higher up as proved by the half dozen young elm trees with exposed roots mentioned above in subdivision VIII.

In this region submergence also plays quite an important part. The area, lying between the south bridge and the region where the original ditch branches off (fig. I) was almost dry

with but a little stream of water during the latter part of the summer and the fall of 1916. But during the whole winter and the present spring ~~the spring~~ the stream has become three times as wide as that in the fall, and near the end of the south bridge water reaches within a foot from the cement wall. Thus the vegetation growing at such a place corresponds to that of the "strand stage" described by Nichols (3). Here the surface of the ground is exposed for the latter part of the summer and the fall but is covered with water during the winter and the spring. In such habitats "the predominant vascular plants are either annualsor herbaceous perennials, or biennials,--forms which are able to develop between successive periods of submergence". Or else plants of more or less pronounced "amphibious proclivities". Some of the best representatives are: rye cut grass (Leesia oryzoides), spike rush (Eleocharis), barnyard grass (Echinochloa), soft rush (Juncus effusus), common thistle (Cirsium lanceolatum), rag weed (Ambrosia trifida), and cocklebur (Xanthium commune) (3). All of these are found either in subdivision I or VIII in the partly submerged zone, and all but one are annuals.

These, however, are not the only vegetation in this region. Panicum, Scirpus and one or two species of Carex are also present in such habitats. Another distinctly separate group in this section might be turned the sedge-grass associes which is formed as a unit of succession and occupies an area a little north of the "strand stage". The most dominant species of the associes are Panicum virgatum and Muhlenbergia with a few patches of Scirpus fluviatilis which altogether occupies

almost 50% of the space .. Xanthium and willows are very common too. Other secondary species are Elymus virginicus, Panicum capillare, Polygonum Hydropiper, etc..

The area to the west along the original ditch has been quite disturbed by man by cutting of woody plants. The character of the vegetation, however, can be easily determined by the large number of relics left.. The willows are the largest trees--some over ten feet high.. Maple and elm have also become trees of good size though they are not quite so tall as the willows. Button bush (Cephalanthus occidentalis) which is a typical plant of swampy places is also present here. With the exception of willow which is a typical pioneer of a young flood plain(6) and the button bush, all the rest of trees--namely, elm, ash, and maple--strongly characterize a true mesophytic forest of a flood plain. According to Cowles the first plants in such habitats are Ambrosia, then comes other annuals followed by willows(Salix nigra and S. longifolia) then by elm, basswood, walnut, button bush, maple, and ash. With these, climbers, such as Virginia creeper, poison ivy, grape vine and some other of the same nature are very common, besides a very luxuriant undergroth characterized by spring-flowering plants and very mesophytic herbs. A forest of such a type might have developed here, had the place been left untouched by human hands. As it is, a meadow characterized by Poa pratensis and Agrostis alba covers a part of the area.

Thus there is at present a competition going on between the development of a pure meadow and of a true mesophytic forest. Because of the human interference, it is hard to de-

cide which will be the final stage, but at present the area included in this subdivision presents to us a sort of mixture of four succession units, (1) the strand stage, (2) the sedge-grass stage, (3) the mesophytic forest, and (4) the flood-plain meadow.

On the top of the ridge the scarcity of vegetation is due to the severe conditions resulting from several causes. A glance at table II enables us to see that in this region erosion is active, water content is low, light intensity is high, and the relative humidity is very low, while in addition the grazing of animals and the fact that it is a frequently used pathway of human trampers--all put together leave very little chance for plants to survive. The soil is a fine sandy loam but with a high percent of gravel which still further prevents an easy growth for many plants. As a result, at places, Euphorbia maculata and Poa pratensis or Sporobolus neglectus are the only plants hardy enough to grow in such a habitat, since they are able to exist under the most xerophytic conditions. The growth of elm seedlings along the furrows is due partly to the improved conditions along such places and partly to the ecesic factors, which come in and play an important part here. Gleason says, "The first step in succession (in a mixed forest association) depends upon the introduction of seeds by wind or animals. The species most frequently introduced in this way are Ulmus americana, and Fraxinus pennsylvanica, both of which have light winged seeds". (1). The ecesis of Ulmus is aided also by the fact that the percentage of germination is high so that Ulmus seedlings are able to be the pioneers even

if the conditions for a mesophytic forest are not yet quite ready. In this region should the elms be left alone as they are and should the erosion process be not too severe, a mesophytic forest might be easily developed in the near future.

Toward the north end, vegetation is more luxuriant but is largely ruderal. Rumex and Cirsium which are found here are among the most universally distributed of weeds and are common on all soils (7), and Melilotus, Chenopodium, Ambrosia, and Lactuca are all common weeds which grow any where along road sides and in waste places.

Thus the different succession types in this region may be called (1) the Euphorbia-Poa associes, (2) the elm consocies, and (3) the weed associes.

The important point in connection with subdivision III and that most worthy of mention is the fact that plants characteristic of very different habitats grow together side by side. On one hand a considerable number (more than a dozen in this small area) of plants of primrose (Oenothera biennis) which is a characteristic plant of the "Middle beech" (4) and which grows largely in open places, indicates a xerophytic habitat. Of similar nature is Populus, Poa pratensis, and Lactuca scariola. On the other hand Acer, Fraxinus, Salix, Muhlenbergia--all give us an impression of a mesophytic region. The mesophytism is more strongly confirmed by the presence of a patch of moss (Ceratodon purpureus) and also by the figures given in table II. In a word this represents a transition from xerophytic to mesophytic conditions. The ultimate fate will no doubt be a mesophytic forest unless artificial in-

terference should prevent.

Subdivision IV is very much like subdivision II in every respect especially high upon the ridge where likewise no vegetation except Euphorbia maculata and Poa pratensis is to be found. On the east slope, however, there is considerably more vegetation. Instead of elms alone, ash, poplars and oak are present, though elm is still the most dominant species. So likewise there are (1) the Euphorbia-Poa associes, and (2) the elm-ash-poplar associes.

Not much explanation is needed in regard to subdivision V. Of the two distinct zones the first may be called the Melilotus alba zone. The explanation of this has already been given. Another possible cause, however, may be mentioned, namely that of direction. The whole patch of Melilotus is along the south slope of the ridge and is thus protected from wind and exposed to the sun. The second area is the shrub-young tree zone which seems to be characterized by the six honey locust trees and young elms, willows and poplars. The source of the Gleditsia is not clear. But as this species is of semi-mesophytic nature and as its fruits are eaten by birds and animals, undoubtedly the seeds have been introduced by biotic agents to this place and they have found the ecological conditions favorable. It is clear that the tendency here is also toward a mesophytic climax forest of maple, elm, ash, etc.

In connection with the vegetation of subdivision VI, quite a number of ecological factors are playing important parts but the most active of all and the most determinative is the process of erosion. Because of the action of erosion, vege-

tation becomes scarce at places although the water content and relative humidity are no more severe than in other stations. Transeau (8) in his work on bog plant societies of North America, divided swamps into two classes--the undrained and the drained swamps. The undrained swamps are the true swamps and the drained swamps are the habitats along stream courses. To a certain extent the region of this subdivision is quite similar to the latter type of swamp and a number of plants which are mentioned by Transeau are also present here such as Scirpus fluviatilis, Juncus effusus, Carex riparia, and Ulmus americana. But willows and Xanthium are the most prominent species in this subdivision and they are not included in the list of plants given by Transeau. According to the types of vegetation, we may subdivide the region into sections. Along the gentle slope north of the original creek is the area of Xanthium and grass characterized by Xanthium commune, Panicum, and Carex with a few willow seedlings. Another section is the willow-sedge area. Here the willow (S. nigra) and Carex occupy more than 60% of the whole vegetation. A little further north is the third portion made up of nothing but willows and xanthium along the water edge and higher up no vegetation at all save Euphorbia maculata and Poa pratensis. Tufts of cinquefoil (Potentilla monspeliensis) were found in some of the crevices. By Cooper (9) Potentilla tridentata is considered as "by far the most important of the early arrivals", in crevices. Our species (P. monspeliensis) seems quite similar to P. tridentata and on account of its abundant and dense growth is undoubtedly one of most important pioneers in such habitats. The fourth distinct

type in this region is the area dominated by willows. Although other plants are also present, the willows occupy a very dominant position. Finally there is a region of willows once more mixed with Carex which extends to the extreme north and where the vegetation becomes again of a very luxuriant ruderal nature. The habitat at this end is quite mesophytic as proved by the presence of two maple seedlings and some vines (Vitis).

Thus the five distinct types of vegetation are (1) Xanthium-grass, (2)willow-sedge, (3) Xanthium-willow, (4) willow, and (5) weeds.

The fact that the whole eastern slope along the ditch is much more thickly populated than the west slope has already been partly explained. In addition, it may also be taken into account that this is the constructive side of the stream since here deposition instead of erosion is going on. Along this side of the stream the vegetation is composed of such a complex of species that it is rather difficult to divide the region into distinct sections. The section at the extreme north end is really a continuation of subdivision III which would, if it had been left alone, be a stage more advanced in succession than the rest. But burnings and cuttings have left the place difficult to classify. At places where destruction was not quite complete willows, Ambrosia, Carex and grasses are always abundant, such a section may be called a willow-sedge-grass associes. The second distinct region is along the steepest portion where like any other place of similar conditions, the soil is occupied by the pioneers, Euphorbia maculata, Poa pratensis and a few willow seedlings. Clear down at the water level, however,

another associes of sedge and grass occurs. From this place on to the south bridge the area is occupied by a mixture of plants to which the best name applicable would be the stage of shrub, and annual and perennial herbs--characterized by willow, elm, and poplar as shrubs, the dominant herbs being Melilotus , Panicum, Ambrosia, and some asters. A single plant of Eupatorium serotinum which is a rather rare species in this region was found in this area.

To summarize then the comparatively distinct areas would be (1) the willow-sedge-grass associes, (2) the Poa-Euphorbia asscoies, and (3) the shrub-herb associes.

Conclusions.

1. Along the lower bank of the stream all evidence indicates a tendency from semi-hydrophytic to mesophytic. Plants of semi-aquatic nature such as Xanthium, Panicum, Salix, Carex, etc, are the pioneers and they prepare the way for mesophytic vegetation to come in.

2. Higher up and on the top of the bank the tendency is from xerophytic to mesophytic. Euphorbia maculata and Poa pratensis are the most typical pioneers.

3. The large number of annuals in the lists of plants of the different subdivisions show that the vegetation on the whole is rather young with the exception of the area occupied by the remnant of the old forest.

4. The succession toward a mesophytic climax forest is taking place with surprising rapidity.

5. The final stage of vegetation in this region would be a mesophytic climax forest, if the place were to be left free from interference by human hands.

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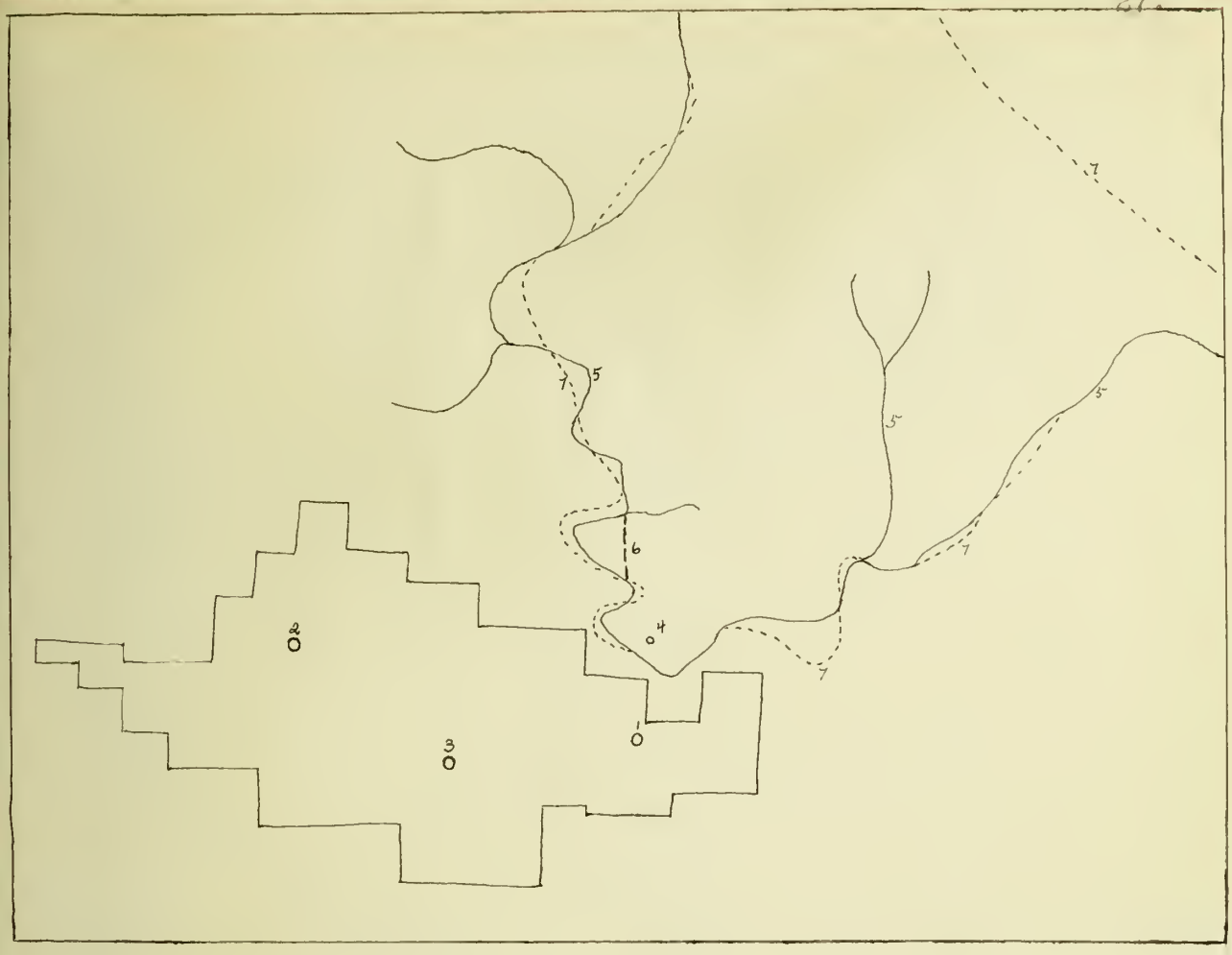

Figure I. Map of a portion of Champaign County. (1)= Urbana City, (2)= Champaign City, (3)= University Station, (4)= Crystal Lake, (5)= Salt Fork Creek, (6)= region studied, (7)= boundary of forest area in the past.

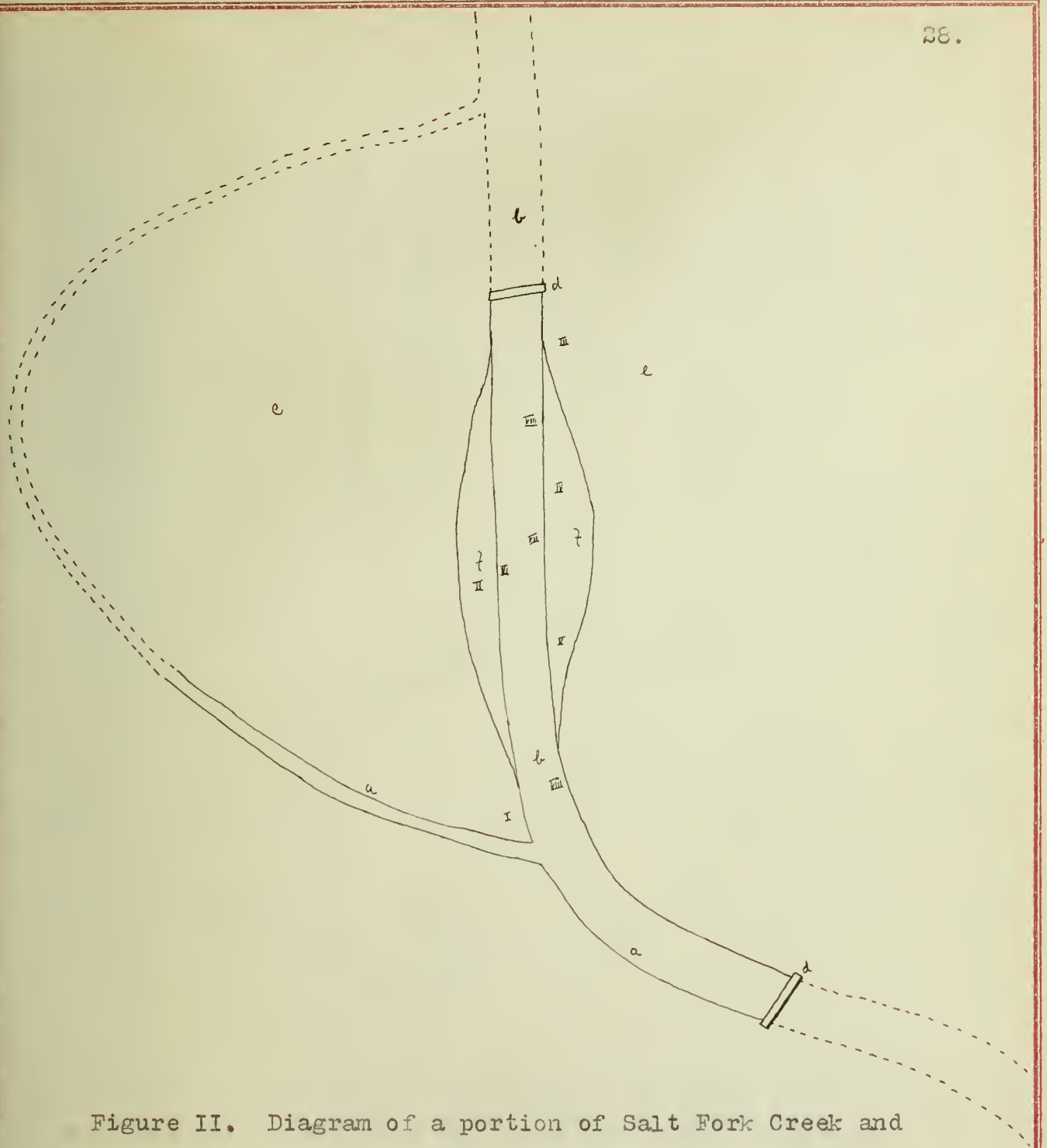

Figure II. Diagram of a portion of Salt Fork Creek and surrounding area. (a)= original course of the creek; (b)=present course (corresponding to (6) in figure I); (c)= pasture land; (d)=bridges; (e)= remnant of an oak forest; (f)= banks.

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